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UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

SECURITIES AND EXCHANGE COMMISSION,	
Plaintiff,	**19 Civ. 9439 (PKC)**
-against-	**ECF Case**
TELEGRAM GROUP INC. and TON ISSUER INC.,	**Electronically Filed**
Defendants.	

Expert Report
of
Carmen A. Taveras, Ph.D.

December 20, 2019

Carmen A. Taveras, Ph.D.

Washington, D.C.

I. Qualifications and Compensation

1. I am a Financial Economist in the Division of Economic and Risk Analysis at the U.S. Securities and Exchange Commission ("SEC").
2. I joined the SEC in July 2014. Prior to joining the SEC, I was a principal at Securities Litigation and Consulting Group. I received a Ph.D. in Economics from the Massachusetts Institute of Technology, a Postgraduate Diploma in Macroeconomics from the Pontificia Universidad Católica in Chile, and a B.A. in Economics from the Pontificia Universidad Católica Madre y Maestra in the Dominican Republic. In addition, I taught graduate and undergraduate courses in economics at the Massachusetts Institute of Technology. My resume is attached as Appendix A. The resume includes a list of all publications authored and a list of all cases in which I testified as an expert at trial or by deposition in the last four years. A list of the materials that I have considered and relied upon in forming my opinions is attached as Appendix B.
3. I receive an annual salary for the performance of my duties at the SEC. I have not been specially compensated for the preparation of my report nor is my salary in any way dependent upon the outcome of this case.

II. Assignment

4. This case involves Telegram Group Inc. ("Telegram") and TON Issuer Inc. ("TON Issuer"), two corporations incorporated in the British Virgin Islands.[1] TON Issuer is a wholly owned subsidiary of Telegram.[2] Pavel V. Durov serves as director to both Telegram and TON Issuer (collectively, "the Defendants").

5. In 2013, Pavel Durov and Dr. Nikolai V. Durov (together, "the Durovs") founded and released Telegram Messenger ("Messenger"), a messaging application that allows users to send messages, photos, videos and files via chat to groups of up to 200,000 people.[3] The Durovs became interested in developing a blockchain that would integrate with their existing Messenger application and would be a faster and more scalable alternative to

[1] Form D, February 13, 2018, p.1. (See Appendix B for full references).
[2] Purchase Agreements for Grams (TG-001-00000020, TG-003-00000233).
[3] Messenger FAQ: https://telegram.org/faq#q-what-is-telegram-what-do-i-do-here. Telegram Pre-Sale Primer, January 18, 2018, pp. 21-22.

existing cryptocurrencies, like Bitcoin and Ethereum.[4] By the end of 2017, the Defendants distributed promotional material for the sale of a new cryptocurrency, Telegram Open Network ("TON" or "TON Blockchain") tokens called Grams, to prospective investors.[5] The promotional material stated that an account called the "TON Reserve" would be set up to hold a portion of the original supply of Grams and that the TON Reserve could intervene in the market buying and selling Grams after the launch of the TON Blockchain to prevent sudden spikes and falls in the market price for Grams.[6] Between January and March 2018, the Defendants raised $1.7 billion in two rounds of a private placement offering of securities.[7] The Defendants committed to deliver Grams to the purchasers following the development and launch of the TON Blockchain.[8]

6. The Defendants' promotional materials describing Grams included a formula for the "Reference Price" of Grams, which, among other things, set the the predetermined price at which Grams would be initially sold to investors. I have been asked to:

    a) Describe the Reference Price formula, in layman's terms;

    b) Calculate the discounts received by Gram investors in the private placement with respect to the expected Reference Price at the TON Blockchain launch; and

    c) Opine on whether the TON Reserve's ability to buy and sell Grams can guarantee price stability for Grams.

7. I reserve the right to supplement my opinions if presented with new documents or data.

III. Summary of Opinions

8. Based on my analysis, I find that:

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[4] Telegram Pre-Sale Primer, January 18, 2018, pp. 3-4, 11.
[5] TON Two Page Teaser and TON Four Page Teaser.
[6] TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000209—10).
[7] Form D, February 13, 2018 and March 29, 2018.
[8] See Purchase Agreements for Grams (TG-001-00000024, TG-003-00000236). I refer to the individuals and entities that entered into Purchase Agreements with the Defendants entitling them to receive Grams as the "purchasers."

a) The Reference Price of Grams is given by an exponential formula and is a function of the total number of Grams in circulation — each subsequent Gram is sold at at least one billionth of a dollar higher than the previous Gram;
b) Gram investors received large discounts from the expected Reference Price at launch;
c) The TON Reserve's ability to buy and sell Grams pursuant to the Reference Price formula is not enough to guarantee stability in the market price of Grams.

9. The remainder of my report provides support for my opinions.

IV. Description of the Documents Reviewed

10. In writing this report, I reviewed the Defendants' Form D filings with the SEC, promotional material and other documents produced to investors in the private placement and Telegram's memoranda to the SEC. I also obtained data on pricing history for cryptocurrencies from Bloomberg Finance, L.P. and CoinMarketCap. A full list of the documents I relied upon for my report is attached as Appendix B.

V. The Reference Price of Grams Is Given by an Exponential Formula and Is a Function of the Total Number of Grams in Circulation — Each Subsequent Gram Is Sold at at Least One Billionth of a Dollar Higher than the Previous Gram

A. Blockchain, Digital Token, and Initial Coin Offerings

11. A blockchain is a digital distributed ledger of transactions, a database or list of entries that is shared and synchronized across multiple participants in a network of computers. Blockchain technology uses cryptography to enable the private transfer and storage of digital assets called tokens.
12. An entity may issue tokens on a blockchain in an effort to raise capital in what is known as an Initial Coin Offering ("ICO"). From the point of view of investors, tokens can provide investment opportunities like those offered by stocks or other more traditional forms of securities.
13. The Defendants raised capital through their sale of Grams to private placement purchasers in order to develop their TON Blockchain technology, among other specified uses.

Following the successful development and launch of the TON Blockchain, Defendants expect Grams to trade in the secondary open market, like other digital tokens.[9]

B. Description of the Reference Price Formula

14. The original supply of Grams or total Grams in circulation is limited to 5 billion Grams.[10] The Defendants expect the supply to increase slowly at a rate of approximately 2% per year. The expected annual increase in supply will be used to reward blockchain validators, who are participants responsible for verifying blockchain transactions.

The original sale price of Grams is set by what the Defendants call the "Reference Price" formula which is given as follows:

$$p(n) = p_0 \cdot e^{\alpha n} \qquad \text{(Eq. 1)}$$

where $p_0 = \$0.1$ or 10 cents and $\alpha = 10^{-9}$.

15. According to this formula, the price of the first Gram to be sold will be $0.10. The price of every subsequent Gram will be at least one billionth of a dollar higher than the price of the previous Gram.[11]

16. Exhibit 1 shows that the Reference Price $p(n)$ increases when the number of Grams in circulation increases. Following the formula, the first Gram would be sold at $0.10, the second Gram would be sold at $0.1000000001, the third Gram would be sold at $0.1000000002, and so on. If each Gram sold is sold sequentially at a price set by the formula, the sale price of each Gram will be dependent on the timing of the sale. As an alternative, the Defendants allowed for the bulk sale of Grams during the initial distribution of Grams.[12] In these bulk sales, orders for buying Grams are collected over a period of time and processed at the same time. The total sum of dollars T needed to buy a certain number of Grams, Δn, can be derived from Eq. 1.[13] All buyers in a bulk sale obtain their Grams at

[9] Telegram's Second Supplemental Memorandum to the Staff of the SEC, February 27, 2018 *[sic]*, p.14.
[10] This section summarizes sections of the TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000207—11).
[11] The formula can be approximated as follows: $p(n) \approx 0.1 \cdot (1 + 10^{-9})^n$, which is an equivalent way of representing the Reference Price of the first Gram sold and every subsequent Gram sold thereafter.
[12] TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000211).
[13] A formula derived from Eq. 1 can be used to calculate the number of Grams, Δn, that can be purchased with T dollars.

the same average price T/Δn. The private placement offering of Grams was done in two rounds of bulk sales, as described in more detail in the next two paragraphs.

C. Allocation of Grams

17. The first round sales occurred between January 29 and February 13, 2018.[14] During this period, the Defendants raised $850 million (*T*) from the sale of approximately 2.25 billion Grams (Δn) at a price of approximately $0.38 per Gram (T/Δn, from the equation in the paragraph above). The exact price and number of grams are shown in Exhibit 2. The Grams sold in the first round had sale restrictions, also called lock-up periods, of up to 18 months after the TON Blockchain launch date.[15]

18. According to Telegram's Form D, the second round sales occurred between March 14 and March 29, 2018.[16] During this period, the Defendants raised $850 million (*T*) from the sale of approximately 639 million Grams (Δn) at a price of approximately $1.33 per Gram (T/Δn). The exact price and number of grams are shown in Exhibit 2. The Grams sold in the second round could be sold after the TON Blockchain launch date without restrictions.[17]

19. In sum, approximately 2.9 billion Grams were sold in private placement in the first quarter of 2018. In this way, the Defendants allocated 58% of the total original supply of 5 billion Grams to investors in the private placement. The remaining 42% of the original supply is expected to be distributed as follows: [18]

    a) 200 million Grams (4% of the original supply) is to be used as rewards to developers of the TON software with a four-year vesting period after the TON Blockchain launch date. The list of developers includes the Durovs.[19]

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[14] Form D, February 13, 2018, pp. 4, 6.

[15] Purchase Agreement for Grams (TG-001-00000022, 27—28). One quarter of the Grams sold in the first round will be released from their lock-up 3 months after the TON Blockchain launch; another quarter, 6 months after launch; another quarter, 12 months after launch; and the remaining quarter, 18 months after launch.

[16] Form D, March 29, 2018, pp. 4, 6.

[17] Purchase Agreement for Grams Stage A of the Subsequent Sale (TG-003-00000234).

[18] TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000210). Fourth Supplemental Memorandum to the Staff the SEC, July 25, 2019, p. 1.

[19] Telegram Pre-Sale Primer, January 18, 2018 (TG-001-00000074).

b) 500 million Grams (10% of the original supply) is to be transferred to the "Incentives Pool" which sets aside part of the supply to reward certain participants in the TON Blockchain network.[20] The Incentives Pool is expected to be used to reward Messenger users for activating their TON Wallets — which would allow for payments using Grams — as well as encourage validators, storage providers and other service providers on the TON Blockchain.

c) The remaining 1.4 billion Grams (28% of the original supply) is to be transferred to the TON Reserve, an account that can sell the Grams it holds into the market at the Reference Price or above. The number of Grams, *n*, in circulation excludes the Grams kept in the TON Reserve.[21]

20. At the time of the TON Blockchain launch, the total number of Grams in circulation is expected to be approximately 3.6 billion, given by the sum of the Grams sold in the private placement and the Grams to be transferred to the developers and the Incentives Pool (excluding the Grams kept in the TON Reserve). After the launch, the TON Reserve may sell Grams at a minimum price given by the Reference Price formula. The first Gram from the TON Reserve would be sold at approximately $3.62 (the Reference Price at launch) or above and every Gram sold thereafter will have an increasing minimum price (dictated by the Reference Price formula).

21. Exhibit 2 and Exhibit 3 summarize the allocation of the original supply of Grams as well as the Reference Price and transaction prices for each of the sales or transfers of Grams described in this section.

D. Market Price and the TON Reserve's Ability to Buy and Sell Grams

22. The market price of Grams will be given by demand and supply and need not be close to or correlated with the Reference Price, which is predetermined by the number of Grams, *n*, in circulation.

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[20] Although these Grams may not all be distributed by the TON Blockchain launch date, it appears that Grams transferred to the Incentives Pool are deemed in circulation. See TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000210, A.4.6) and Fourth Supplemental Memorandum to the Staff the SEC, July 25, 2019, p. 2 on Incentive Payments).

[21] TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000210, A.4.6)

23. The documents promoting the private placement state that if the market price of Grams increases above the Reference Price, *p(n)*, the TON Reserve may, but is not required to, sell Grams at or above the Reference Price, increasing the total number of Grams in circulation, *n*.[22] Similarly, if the market price of Grams falls below half of the Reference Price, the TON Reserve may, but is not required to, buy Grams back and decrease *n*. Although later documents address the buyback price specifically, stating that the TON Reserve may buy back Grams at the TON Reserve "Maximum Purchase Price" or half of the Reference Price, the offering documents are not as precise.[23] The Technical White Paper, for example, discusses the buyback of Grams by the TON Reserve but does not limit the maximum buyback price to half of the reference price. More generally, neither the offering documents nor the Defendants' memoranda to the SEC provide information as to the circumstances under which the TON Reserve will in fact exercise its discretion to buy or sell Grams.

24. The stated purpose of the TON Reserve's ability to buy and sell Grams is to prevent sudden spikes or falls in the market price.[24] However, the TON Reserve's ability to buy and sell Grams is likely to have a limited effect on the market price of Grams, as discussed further herein.

VI. Gram Investors Received Large Discounts from the Expected Reference Price at Launch

25. Telegram's representations to potential and actual investors changed over time. Exhibit 4 summarizes my understanding of certain representations from the documents I reviewed

[22] See for example the TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000209—10)

[23] Telegram's June 26, 2018 Memorandum to the Staff of the SEC provides more detail regarding the functioning of the TON Reserve. It states that the responsibilities related to the TON Reserve will be transferred to the TON Foundation, which is described as a not-for-profit organization "separate from Telegram" (p. 13) but the Durovs are expected to be two of initial board members (Defendants' Responses and Objections to Plaintiff's First Set of Interrogatories, November 22, 2019, p. 24). For simplicity, in the text of my report I do not differentiate between the TON Reserve and the TON Foundation. Also, see the Supplemental Memorandum to the Staff of the SEC, November 20, 2018, p. 4.

[24] TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000209—10)

that were made available to investors prior to the two rounds of the offering. The first two columns represent what I understand as the most updated information available to investors prior to each of the two rounds of the offering. Exhibit 4 also includes a summary of the offering as of the date of this report (last column).

26. Telegram's January 17, 2018 Indication of Interest Letter (the "January Indication of Interest Letter"), which I understand was shared with investors prior to the first round of the offering, described plans for a "Pre-Sale" and a "Subsequent Sale" of Grams. According to the January Indication of Interest Letter, the Pre-Sale would offer a maximum of US$850 million worth of Grams and would close around February 9, 2018. According to the January Indication of Interest Letter, the Subsequent Sale would commence around March 20, 2018 and had an expected offering amount of $1.15 billion worth of Grams. Exhibit 4 shows a summary of the offering progress, Defendants' descriptions to investors and reasonable investor expectations, based on those descriptions, at the time of the January Indication of Interest Letter, just before the start of the first round of the offering. Based on the January Indication of Interest Letter, a total of 3 billion Grams were expected to be sold over two rounds of sales, raising $2 billion.

27. It appears from the documents I reviewed that by February 20, 2018, Telegram had closed the first round of the offering and was promoting its Subsequent Sale. At the time, Telegram expected the Subsequent Sale to be conducted in two stages: Stage A and Stage B. Telegram's February 20, 2018 Indication of Interest Letter (the "February Indication of Interest Letter") stated that TON Issuer anticipated "offering a subscription for a maximum of US$850 million worth of Grams in Stage A" and "offering subscriptions for a maximum of US$1.7 billion worth of Grams in the Subsequent Sale" — that is both Stage A and B.[25] Exhibit 4 shows a summary of the offering progress and expectations at the time of the February Indication of Interest Letter. The first round of the offering had already closed, raising $850 million through the sale of 2.25 billion Grams (as shown in Panel A). At the time, it appears that Telegram expected to sell up to 3.3 billion Grams and raise a total of $2.6 billion in three rounds of offerings (as shown in Panel B).

[25] The February Indication of Interest Letter (TLGRM-007-00019093)

28. As of the date of this report, Telegram has completed two rounds of offering of $850 million each, through the sale of 2.9 billion Grams as shown in the last column of both Panels A and B of Exhibit 4.
29. Exhibit 4 also shows expected and actual prices for each of the rounds of the offering as well as the expected Reference Price at launch, using the Reference Price formula on Eq. 1 above. The first round (or Pre-Sale) price was expected to be approximately $0.38 per Gram across the time period in Exhibit 4. The second round (or Stage A of the Subsequent Sale) was expected to be from approximately $1.33 to $1.45. The expected Reference Price at launch was approximately $4.23 on January 17, $5.34 on February 20, and $3.62 as of the date of this report, based on the amounts of Grams expected to be sold, or, in the case of the $3.62 reference price, based on the Grams actually sold so far.
30. Investors in the first round of the offering expected to receive a discount of 91.1% from the expected Reference Price at launch, using the information in the January Indication of Interest Letter and the Reference Price formula in Eq. 1. Investors in the second round of the offering expected to receive a discount of 75.1% from the expected Reference Price at launch, using the information in the February Indication of Interest Letter and the Reference Price formula in Eq. 1.
31. At the time of my report, investors in the first round of the offering can expect to receive a discount of 89.6% from the Reference Price at launch. At the time of my report, investors in the second round of the offering can expect to receive a discount of 63.3% from the Reference Price at launch.
32. I have been asked to calculate the profits that Gram investors could expect to realize if the TON Reserve buys back Grams at its Maximum Purchase Price (half of the Reference Price) shortly after launch, assuming that the price of Grams falls and stays below half of the Reference Price. According to my calculations, first and second round investors would make a profit of $5,844,901 each, for a total of $11,689,801 in profits on their $1.7 billion investment.[26] The TON Reserve would need to spend $1.712 billion to purchase back all

[26] This calculation assumes that first and second round investors sell their Grams before Grams from the Incentives Pool are sold back to the TON Reserve.

of the Grams it has sold in the offering, if it purchases them back at half of the applicable Reference Price.

VII. The TON Reserve's Ability to Buy and Sell Grams Pursuant to the Reference Price Formula Is Not Enough to Guarantee Stability in the Market Price of Grams

A) Limits to the TON Reserve's Ability to Keep the Market Price from Increasing

33. About 1.4 billion Grams, 28% of the original supply, is expected to be transferred to the TON Reserve. If the market price of Grams exceeds its Reference Price, the TON Reserve may sell Grams in an attempt to limit price volatility. However, the maximum number of Grams the TON Reserve can sell in the open market is limited to its holdings. Once the TON Reserve depletes its original allocation through sales, all 5 billion Grams will be in circulation and the Reference Price using the formula in Eq. 1 will be approximately $14.84 per Gram, the "Maximum Reference Price."[27] If the market price continues above the Maximum Reference Price of $14.84 the TON Reserve would have no ability to keep the market price below the Maximum Reference Price because it would no longer have any Grams to sell.

B) Limits to the TON Reserve's Ability to Keep the Market Price from Decreasing

34. I have been asked to consider three alternative scenarios regarding the TON Reserve's ability to purchase Grams from the open market;

    a) The remaining proceeds of the offering, about $1.4 billion, are available to support the TON Reserve's buying activities;[28]

[27] For ease of discussion, the description of the limits to the TON Reserve's ability to stabilize prices ignores the expected 2% annual growth rate in the supply of Grams. See TON Technical White Paper distributed as Appendix A to the January 18, 2018 (TG-001-00000208). The description above applies exactly shortly after the TON Blockchain launch and applies, with small changes, after the supply of Grams increases as validators in the TON Blockchain are paid with the issuance of new Grams. For example, one year after the TON Blockchain launch the supply of Grams is expected to increase by an average of 2% and the Maximum Reference Price is expected to increase to approximately $16.40. My descriptions above similarly apply with a changing Maximum Reference Price that would be approximately $16.40 one year after launch and increasing thereafter due to the expected 2% annual growth rate in the supply of Grams.

[28] The source for the remaining offering proceeds is Telegram's Second Supplemental Memorandum to the Staff of the SEC, February 27, 2018 *[sic]*, p. 6.

b) The TON Reserve can only buy Grams from proceeds it may realize from sales of Grams after the TON Blockchain launch date;[29]

c) The TON Reserve cannot buy back Grams from the open market.[30]

35. First, I consider an example in which the TON Reserve has access to the full $1.4 billion to support its buying activities. In the event that the market price falls below $1.81 or half of the Reference Price at launch, the TON Reserve has the discretion, but not the obligation, to buy back Grams from the market at up to half of the Reference Price, defined as the TON Reserve Maximum Purchase Price. If all of the second round purchasers (which have no lock-up period) sell back their 639 million Grams to the TON Reserve and the market price stays sufficiently low (below approximately $0.96 per Gram), the TON Reserve would spend approximately $856 million to buy back all of Grams from the second round purchasers if the TON Reserve purchased at half of the applicable Reference Price.

36. Next, if three months after launch, all of the first round purchasers sell the 562.8 million Grams with a lock-up period of three months and the market price stays sufficiently low (below approximately $0.54 per Gram) the TON Reserve would spend approximately $412 million in buybacks.

37. If the market price is sufficiently low (below approximately $0.31 per Gram), a buyback similar to that explained above but for the first round Grams with a lock-up period ending six months after launch would require the TON Reserve to spend approximately $234 million, which would exceed its remaining cash balance of around $132 million at this point. Thus, even in the most favorable scenario in which the TON Reserve has access to $1.4 billion for its buying activities, the TON Reserve may not be able to stabilize a price that is below approximately $0.31 per Gram.

38. The second scenario, in which the TON Reserve can only buy Grams from proceeds it realized from previous sales of Grams, even more severely curtails any ability by the TON Reserve to stabilize a decreasing market price.

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[29] Telegram's Second Supplemental Memorandum to the Staff of the SEC, February 27, 2018 *[sic]*, p. 10 states: "the ability of the TON Reserve to purchase Grams is dependent on it first selling Grams and using the proceeds of such sales for any subsequent purchases."

[30] Telegram's Fourth Supplemental Memorandum to the Staff of the SEC, July 25, 2019, p. 1 and Telegram's Third Supplemental Memorandum to the Staff of the SEC, March 18, 201, p. 2 say that Telegram is considering the removal of the TON Reserve's buying function under certain conditions.

39. The third scenario, which eliminates the TON Reserve's buying ability, completely does away with any ability to stabilize a decreasing market price.

C) Market Price Simulations and Empirical Evidence on Other Cryptocurrencies Show that the TON Reserve's Ability to Buy and Sell Grams is Likely Not Enough to Guarantee Market Price Stability

i. Simulations of the Market Price of Grams

40. Exhibits 5A, 5B, and 5C show simulations for the market price of Grams. In all of the simulations, the market price of Grams is assumed to follow a geometric random walk given by the following:

$$ln(P_t^m) = \ln(P_{t-1}^m) + \varepsilon_t \qquad \text{(Eq. 2)}$$

where P_t^m is the market price of Grams at time *t*, $P_{t-1}^m$is the market price of Grams in the previous period, and ε_t is a random variable that is normally distributed with a mean given by μ and a standard deviation given by σ. Geometric random walk models are commonly used in finance to study stock prices.[31]

41. For the purpose of Exhibits 5A, 5B, and 5C, I assume that σ, the standard deviation of the above defined ε_t, is equal to 0.1. The standard deviation, σ, is a measure of volatility. A small standard deviation means that the random variable ε_t is likely to be close to the mean, while a large standard deviation means that the random variable ε_t is likely to be far from the mean.

42. Exhibit 5A assumes that μ, the mean of ε_t, is 0, which means that the market price of the Gram can be expected to increase or decrease with the same probability. Exhibit 5A shows that the market price following this geometric random walk is likely to stay within the bands set in between half of the Reference Price to the Maximum Reference Price. In this scenario, the market price would fall in between half of the Reference Price at launch and the Maximum Reference Price for some period of time as in Exhibit 5A, as a consequence of the μ — the mean of ε_t — assumed to be 0 and σ — the standard deviation of ε_t — assumed to be small. As the time period gets longer though, the more likely the probability

[31] See for example, Campbell, Lo and MacKinlay, "*The Econometrics of Financial Markets*," Princeton University Press, 1997, pp. 11, 16, and 32.

that the random variable ε_t would result in an outlier, either too low or too high, and the resulting price would fall outside of the bands.

43. Exhibit 5B assumes that μ, the mean of ε_t, is 0.02 which means that the random variable component has a positive trend representing an average period over period return of 2%. Exhibit 5B shows that the market price following this geometric random walk formula is likely to exceed the Maximum Reference Price of $14.84 per Gram, leaving the TON Reserve with no ability to stabilize the price down.

44. Exhibit 5C assumes that μ, the mean of ε_t, is -0.01 which means that the random variable component has a negative trend representing an average period over period return of -1%. Exhibit 5C shows that the market price following this geometric random walk formula is likely to approach $0 per Gram. As noted earlier, the TON Reserve's ability to buy back Grams is limited by the funds it holds in US dollars. As described in the previous subsection, even if the TON Reserve had access to all of the remaining proceeds from the offering, its ability to purchase Grams would be limited. Exhibit 5C shows a situation in which the TON Reserve could not prevent a decreasing market price from falling.

ii. Empirical Analysis of Cryptocurrencies

45. An analysis of historical market prices for nine cryptocurrencies validates the parameter choices in the simulations described in Exhibits 5A, 5B, and 5C. I obtained daily prices for four of the top cryptocurrencies: Bitcoin, Ethereum, XRP, and Bitcoin Cash.[32] I also obtained daily prices for five of the biggest ICOs: EOS, Tezos, Paragon, Bancor, and Dragon Coin.[33] I estimated Eq. 2 for each of the cryptocurrencies using a linear regression model, a standard statistical technique used in financial econometrics.

46. Exhibit 6 shows a summary of the results of my regressions. The estimated coefficient for the previous period's cryptocurrency price (denoted as "Lag Price" in the table) is close to 1, as assumed in Eq. 2. This means that today's price is a good predictor of tomorrow's

[32] CoinMarketCap was used to obtain the list of top cryptocurrencies by market capitalization. I excluded Tether from my regression analysis because Tether claimed to be backed 100% by dollar reserves, until around March 14, 2019. Until that date, Tether's closing price is almost always equal or close to $1 and, therefore, regressions, which try to explain the movements in a variable, are not meaningful. See Aaron Hankin, "*Tether Reverses Claim of 100% Dollar Backing, Sparking Criticism,*" Marketwatch, March 14, 2019.

[33] Kharif, Olga, *"How's that ICO Working Out? Breaking Down the Biggest ICOs from the Past Few Years,"* Bloomberg Businessweek, December 14, 2018.

price. The estimated constant in the regressions in Exhibit 6 (denoted by "Constant" in the table) is an estimate of the daily expected return for cryptocurrencies, that is an estimate of μ from the simulated models above. Exhibit 6 shows that the estimated daily returns for the nine cryptocurrencies analyzed ranges from -4.81% to 2.68%, which is a wider range than the -1% to 2% assumed in the simulations.

47. There are two reasons that Exhibit 6 likely underestimates the range in the expected daily return for the TON Blockchain, especially in the first few days after launch. The first reason is that many cryptocurrency projects do not survive. A Boston College study estimated the survival rate of cryptocurrency firms after 120 days from the end of their ICO at 44.2%.[34] By design, an analysis of historical prices as shown in Exhibit 6 only includes ICOs that raise capital and list on an exchange. In addition, all cryptocurrencies in Exhibit 6 are currently active. The same Boston College study finds that 16% of cryptocurrencies that raise capital and list on an exchange become inactive by the fifth month.

48. The second reason that Exhibit 6 likely underestimates the range in the expected daily return for the TON Blockchain is that Exhibit 6 uses all of the available historical data. Some of the cryptocurrencies in Exhibit 6 are well established and have been around for many years. Exhibit 7 shows a similar analysis to that on Exhibit 6 but limits the time period for each regression to the first 100 days with available data. Exhibit 7 shows that the daily expected return, the estimate of the constant, ranges from -29.9% to 55.8%.

49. Exhibit 8 and Exhibit 9 show historical prices for Bitcoin and Dragon, two of the nine cryptocurrencies included in Exhibit 6. Exhibit 8 shows that Bitcoin prices have shot upward towards the middle of December 2017 and again, to a lesser extent, in June 2019; Exhibit 9 shows that the price of Dragon Coin has dropped from $2.21 to close to $0.

50. The historical prices for both Bitcoin and Dragon Coin are extremely volatile. As a way of comparison, Bitcoin's annual volatility is 6.1 times the volatility of the S&P 500, 3.5 times the volatility of Apple Inc., and 1.7 times the volatility of Tesla.[35] Similarly, Dragon's

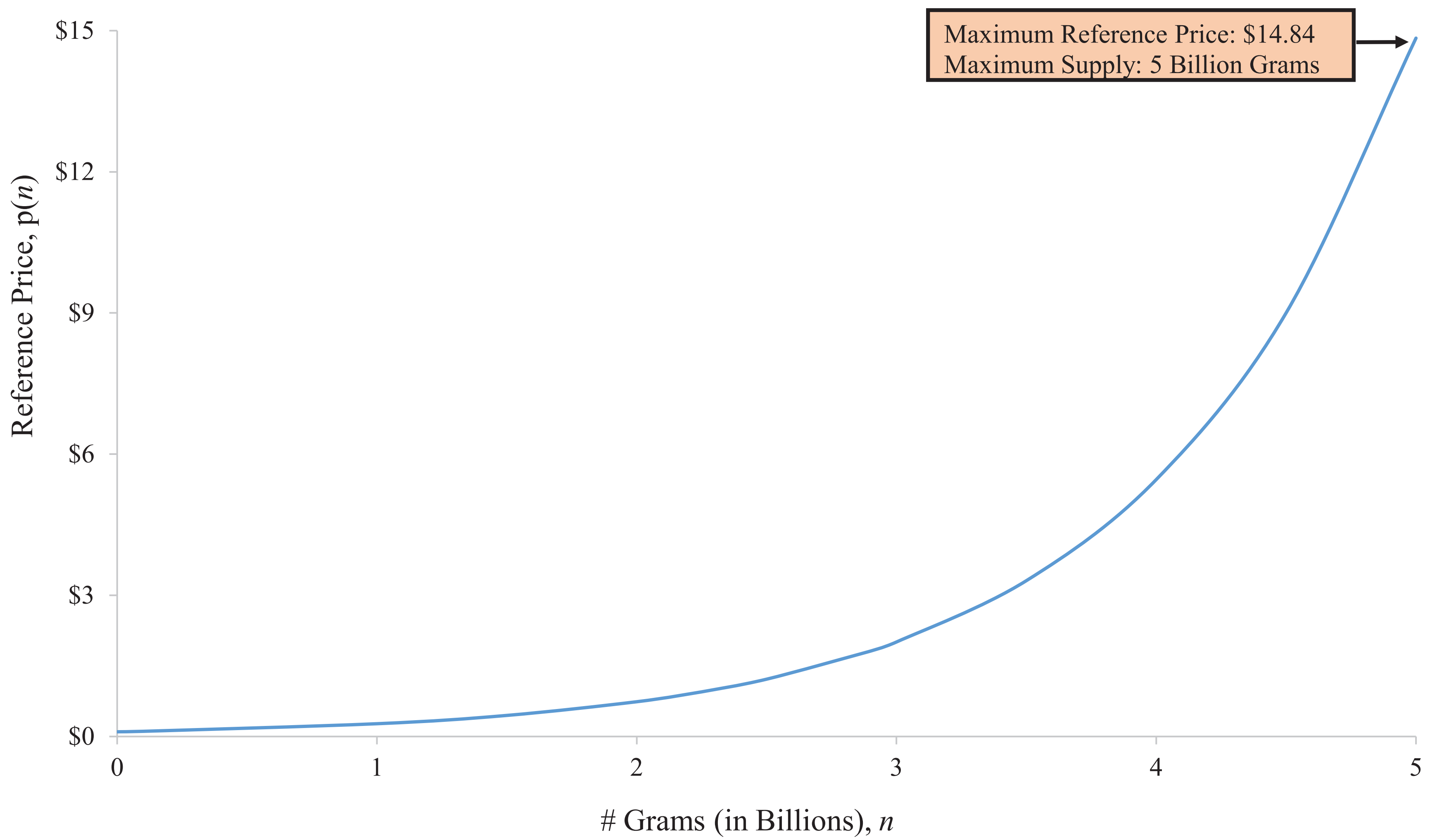
[34] Benedetti, Hugo and Leonard Kostovetsky, *"Digital Tulips? Returns to Investors in Initial Coin Offerings,"* Working Paper, May 20, 2018.

[35] The volatility was calculated using data from January 1, 2010, or the earliest data available, until December 11, 2019.

annual volatility is 19.8 times the volatility of the S&P 500, 11.4 times the volatility of Apple Inc., and 5.5 times the volatility of Tesla.

51. Even if the TON Blockchain is, as Defendants claim, in some ways different from other cryptocurrencies, the market forces of supply and demand that affect the prices of other cryptocurrencies are likely to also affect the market price of the Gram. As my analysis shows, the Gram's market price could: a) stay within bands set by half of the Reference Price and the Maximum Reference Price or b) rise above the Maximum Reference Price or fall below half the Reference Price. The TON Reserve cannot guarantee to keep the market price between these bands. From a financial economics point of view and based on my understanding of the documents I reviewed, there is nothing unique about the Gram or the TON Reserve that would guarantee the market price of Grams to be stable.

Exhibit 1: Reference Price for *n*-th Gram in Circulation (Sequential Sales)


Maximum Reference Price: $14.84
Maximum Supply: 5 Billion Grams
Reference Price, p(n)
$15
$12
$9
$6
$3
$0
0
1
2
3
4
5
# Grams (in Billions), n

Note: For ease of exposition, my exhibits ignore the expected annual growth rate of 2% in the supply of Grams.
Source: TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000208—209).

Exhibit 2: Private Placement and Allocation of Grams Through TON Blockchain Launch

	Price per Gram	# of Grams Under Subscription	Total $ Value Raised
First Round of Private Placement	$0.37756101	2,251,291,799	$850,000,000
Second Round of Private Placement	$1.33003701	639,079,959	$850,000,000
Total in Private Placement		2,890,371,758	$1,700,000,000

	# of Grams to be Transferred
Incentives Pool	500,000,000
Developer Pool	200,000,000
TON Reserve	1,409,628,242

	Reference Price	# of Grams in Circulation
At TON Blockchain Launch	$3.62475487	3,590,371,758

Note:
The number of Grams in circulation does not include the Grams held by the TON Reserve.

Sources:
Purchase Agreement for Grams (TG-001-00000022); Purchase Agreement for Grams Stage A of the Subsequent Sale (TG-003-00000234); TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000207—211); Telegram's Second Supplemental Memorandum to the Staff of the SEC, February 27, 2018 [*sic*], p. 2-3.

Exhibit 3: Price per Gram and Reference Price for *n*-th Gram in Circulation

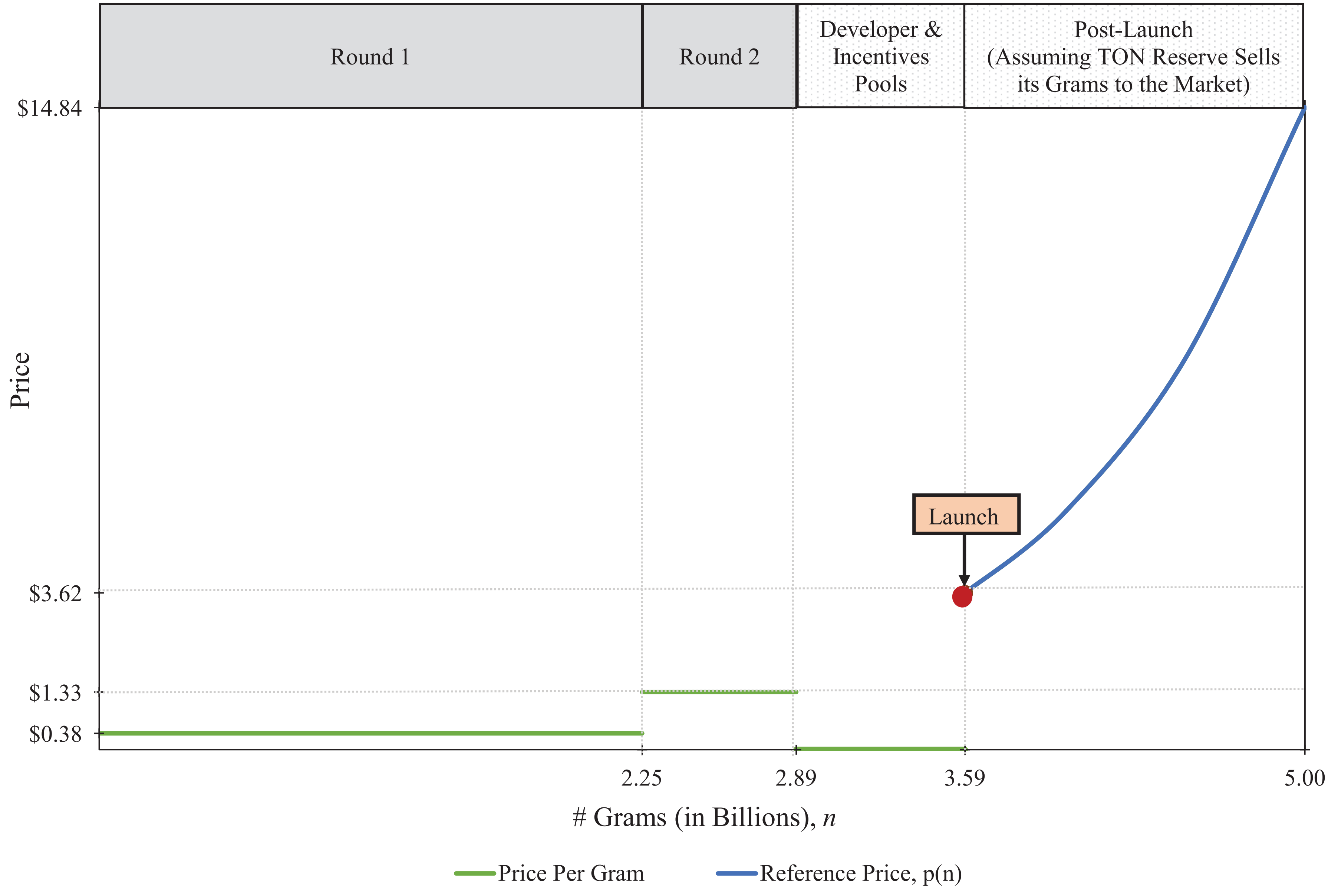

Round 1
Round 2
Developer & Incentives Pools
Post-Launch (Assuming TON Reserve Sells its Grams to the Market)
Price
$14.84
$3.62
$1.33
$0.38
Launch
2.25
2.89
3.59
5.00
# Grams (in Billions), n
Price Per Gram
Reference Price, p(n)

Exhibit 4: Timeline of the Offering and Expectations

	Prior to 1st Round 1/17/2018	Prior to 2nd Round 2/20/2018	At the Time of my Report 12/20/2019
Panel A: Timeline of the Offering			
Dollars Raised So Far	0	$850 million	$1.7 billion
Grams Sold So Far	0	2.3 billion	2.9 billion
Sale Rounds Completed	0	1	2
Panel B: Timeline of Expectations			
Expectation for Total Dollars Raised in the Offering	$2.0 billion	$2.6 billion*	$1.7 billion
Expectation for Grams Sold in the Offering	3.0 billion	3.3 billion*	2.9 billion
# Sale Rounds Expected	2	3	2
Expected Pricing Details			
First Round Price	$0.37756101	$0.37756101	$0.37756101
Second Round Price	$1.44976750	$1.33003701	$1.33003701
Third Round Price	none	$2.19767164*	none
Reference Price at Launch	$4.22888069	$5.33644467*	$3.62475487
Expected Discounts from Reference Price at Launch			
First Round Discount	91.1%	92.9%	89.6%
Second Round Discount	65.7%	75.1%	63.3%

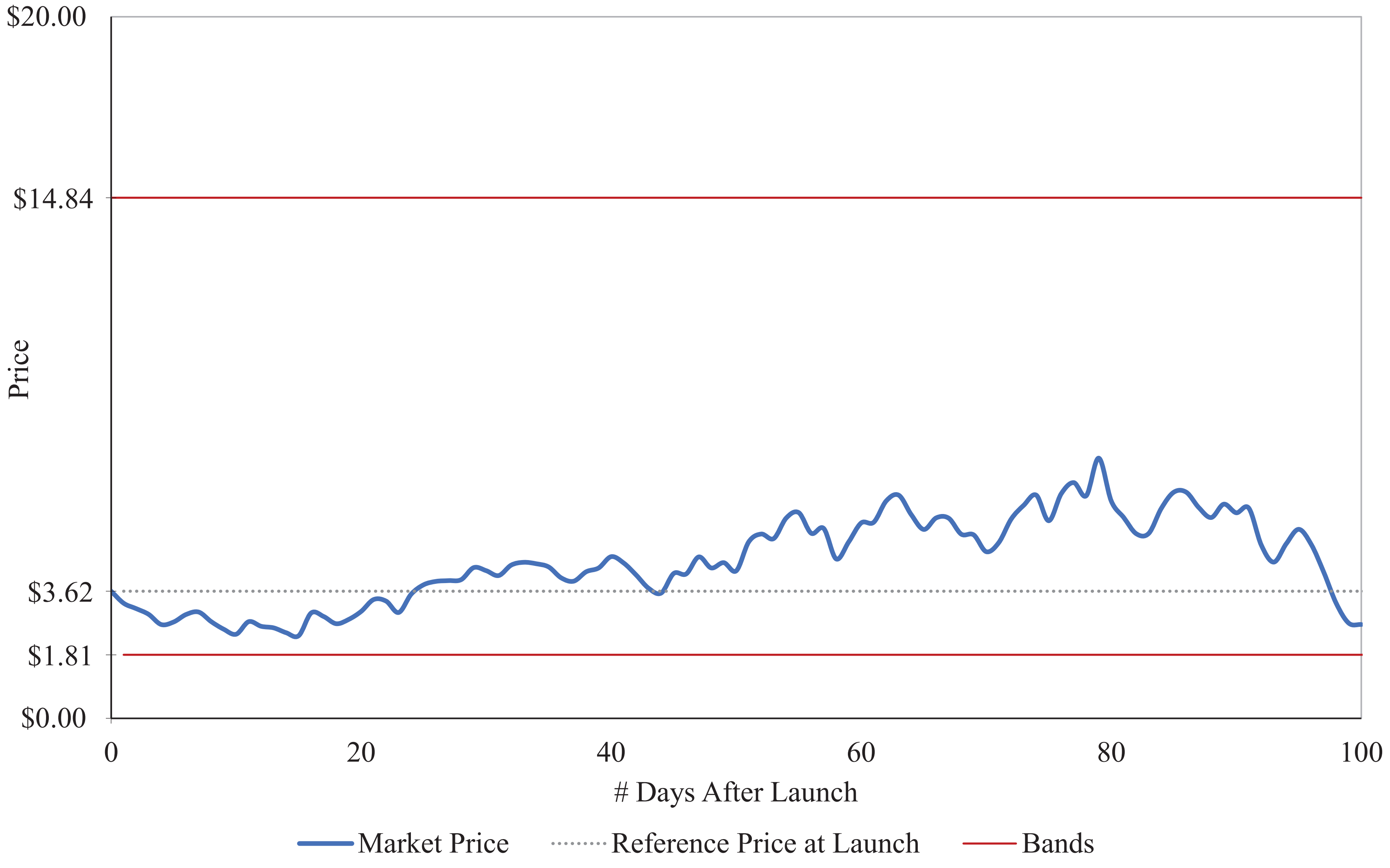
Notes:

The figures under 2/20/2018 marked with an * assume that the maximum of $1.7 billion is raised in the Subsequent Sale, as described in the February Indication of Interest Letter for Stage A of the Subsequent Sale. The above calculations include the 700 million Grams to be transferred to the Developer and Incentive Pools, as specified in the offering documents.

Sources:

January Indication of Interest Letter (KPCB-0000623), February Indication of Interest Letter for Stage A of the Subsequent Sale (TLGRM-007-00019093), and Telegram's Fourth Supplemental Memorandum to the Staff of the SEC, July 25, 2019.

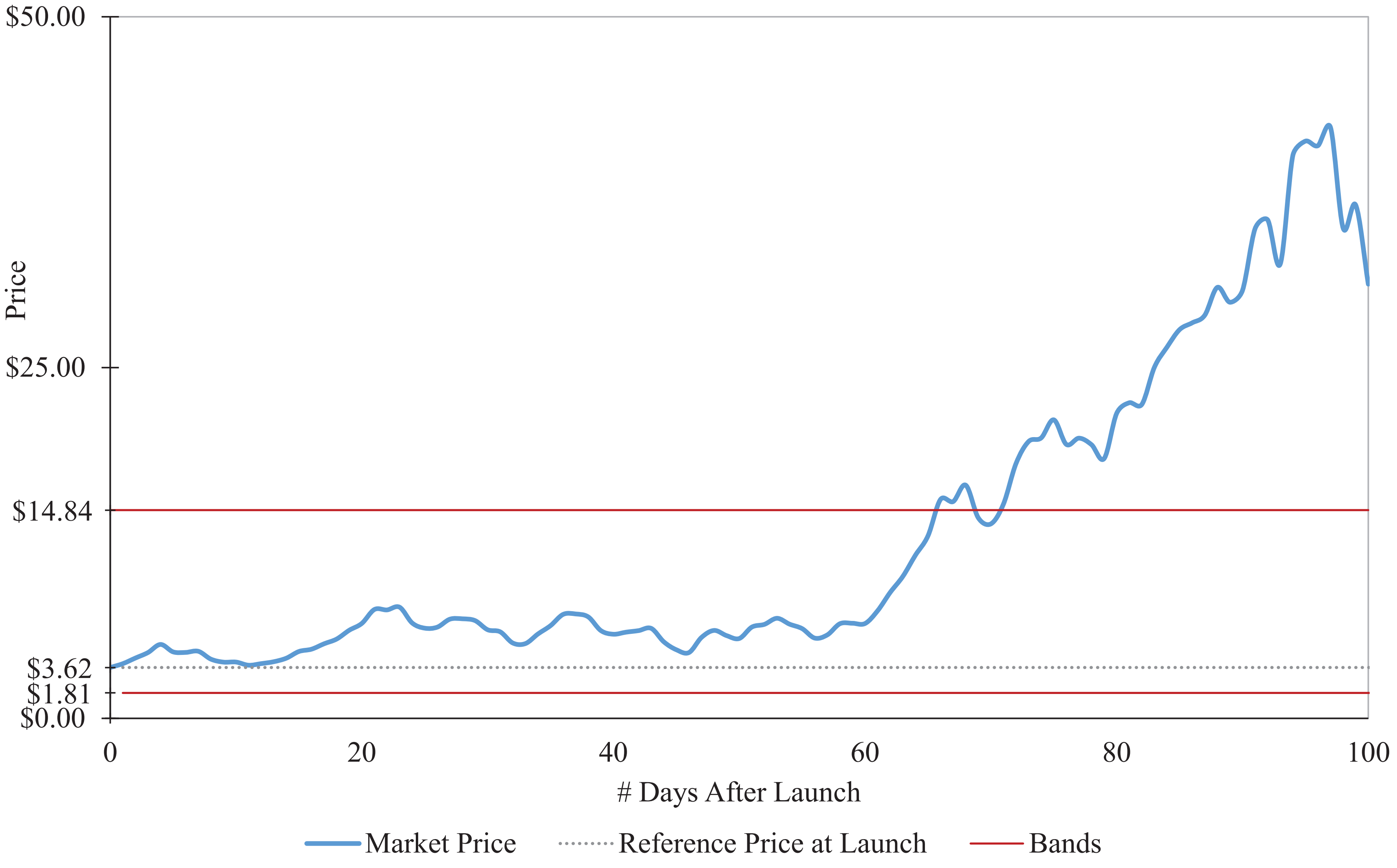
Exhibit 5A: Simulated Market Price (μ=0)



$20.00
$14.84
Price
$3.62
$1.81
$0.00
0
20
40
60
80
100
# Days After Launch
Market Price
Reference Price at Launch
Bands

Note: The top band is the Maximum Reference Price, $14.84, and the bottom band is half of the Reference Price at launch, $1.81. The bands may shift in time if the TON Reserve buys or sells Grams.

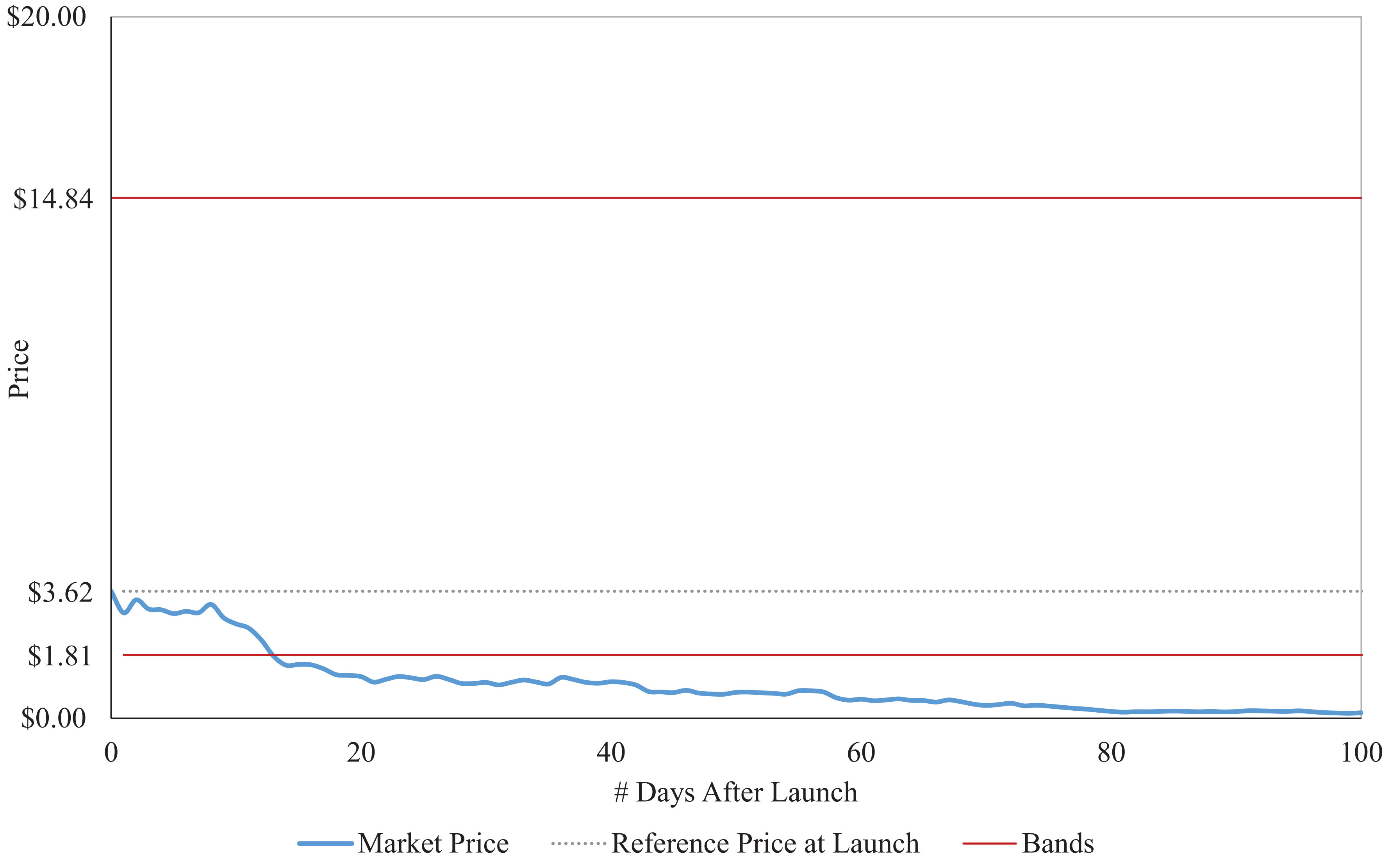
Exhibit 5B: Simulated Market Price (μ=0.02)



Price
$50.00
$25.00
$14.84
$3.62
$1.81
$0.00
0
20
40
60
80
100
# Days After Launch
Market Price
Reference Price at Launch
Bands

Note: The top band is the Maximum Reference Price, $14.84, and the bottom band is half of the Reference Price at launch, $1.81. The bands may shift in time if the TON Reserve buys or sells Grams.

Exhibit 5C: Simulated Market Price (μ= -0.01)


$20.00
$14.84
$3.62
$1.81
$0.00
Price
0
20
40
60
80
100
# Days After Launch
Market Price
Reference Price at Launch
Bands

Note: The top band is the Maximum Reference Price, $14.84, and the bottom band is half of the Reference Price at launch, $1.81. The bands may shift in time if the TON Reserve buys or sells Grams.

Exhibit 6: Estimation of Daily Cryptocurrency Prices

Data for Full Period of Availability

	Bitcoin	Ethereum	XRP	Bitcoin Cash	EOS	Tezos	Paragon	Bancor	Dragon Coins
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lag Price	0.999***	0.999***	0.999***	0.995***	0.993***	0.995***	0.983***	0.994***	0.981***
	(0.000342)	(0.000865)	(0.000773)	(0.00341)	(0.00359)	(0.00367)	(0.00652)	(0.00272)	(0.00599)
Constant	0.0109***	0.00748	-0.000784	0.0268	0.0114*	0.00194	-0.0461**	-0.00305	-0.0481***
	(0.00220)	(0.00396)	(0.00293)	(0.0211)	(0.00577)	(0.00304)	(0.0169)	(0.00268)	(0.0141)
Number of Observations	3138	1587	2320	871	893	800	776	906	631
Start Date	7/19/2010	8/7/2015	8/4/2013	7/23/2017	7/1/2017	10/2/2017	10/26/2017	6/18/2017	3/20/2018
Adjusted R-Squared	1.000	0.999	0.999	0.990	0.988	0.989	0.967	0.993	0.977
Root Mean Squared Error	0.0561	0.0717	0.0729	0.0800	0.0833	0.0756	0.180	0.0774	0.136

Notes:

The regression estimates the natural logarithm of the price on the natural logarithm of the prior day's price. The estimation period for each of the cryptocurrencies starts on the date listed above and ends December 11, 2019.

The adjusted R-Squared is a statistical measure that represents the portion of the variability in the dependent variable (cryptocurrency price) that is explained by the regression model. An adjusted R-Squared close to 1, as in the table, means that almost all of the variability in the cryptocurrency price can be explained by the price in the previous period. The root mean squared error is a statistical measure of the difference between the values predicted by the regression model and the observed values for cryptocurrency prices. It is an estimate of the standard deviation, σ, as defined in the text of my report. The root mean squared error from my regressions ranges from 0.056 to 0.180, which confirms that a standard deviation of 0.1, as assumed in my simulations, is a reasonable parameter choice.

Standard errors in parentheses; * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Sources:

Data is from CoinMarketCap with the exception of Bitcoin data prior to April 28, 2013, which was not available on CoinMarketCap and was obtained from Bloomberg Financial, L.P.

Exhibit 7: Estimation of Daily Cryptocurrency Prices

First 100 Days of Data

	Bitcoin	Ethereum	XRP	Bitcoin Cash	EOS	Tezos	Paragon	Bancor	Dragon Coins
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lag Price	0.989***	0.831***	0.939***	0.908***	0.971***	0.976***	0.886***	0.833***	0.990***
	(0.0190)	(0.0456)	(0.0358)	(0.0425)	(0.0288)	(0.0245)	(0.0450)	(0.0345)	(0.0174)
Constant	-0.0161	-0.0278	-0.299	0.558*	0.000303	0.0335	-0.111*	0.140***	-0.0337*
	(0.0456)	(0.0164)	(0.178)	(0.256)	(0.0156)	(0.0266)	(0.0439)	(0.0371)	(0.0149)
Number of Observations	100	100	100	100	100	100	100	100	100
Start Date	7/19/2010	8/7/2015	8/4/2013	7/23/2017	7/1/2017	10/2/2017	10/26/2017	6/18/2017	3/20/2018
Adjusted R-Squared	0.965	0.770	0.874	0.822	0.920	0.941	0.796	0.855	0.970
Root Mean Squared Error	0.112	0.158	0.110	0.118	0.144	0.114	0.153	0.161	0.117

Notes:

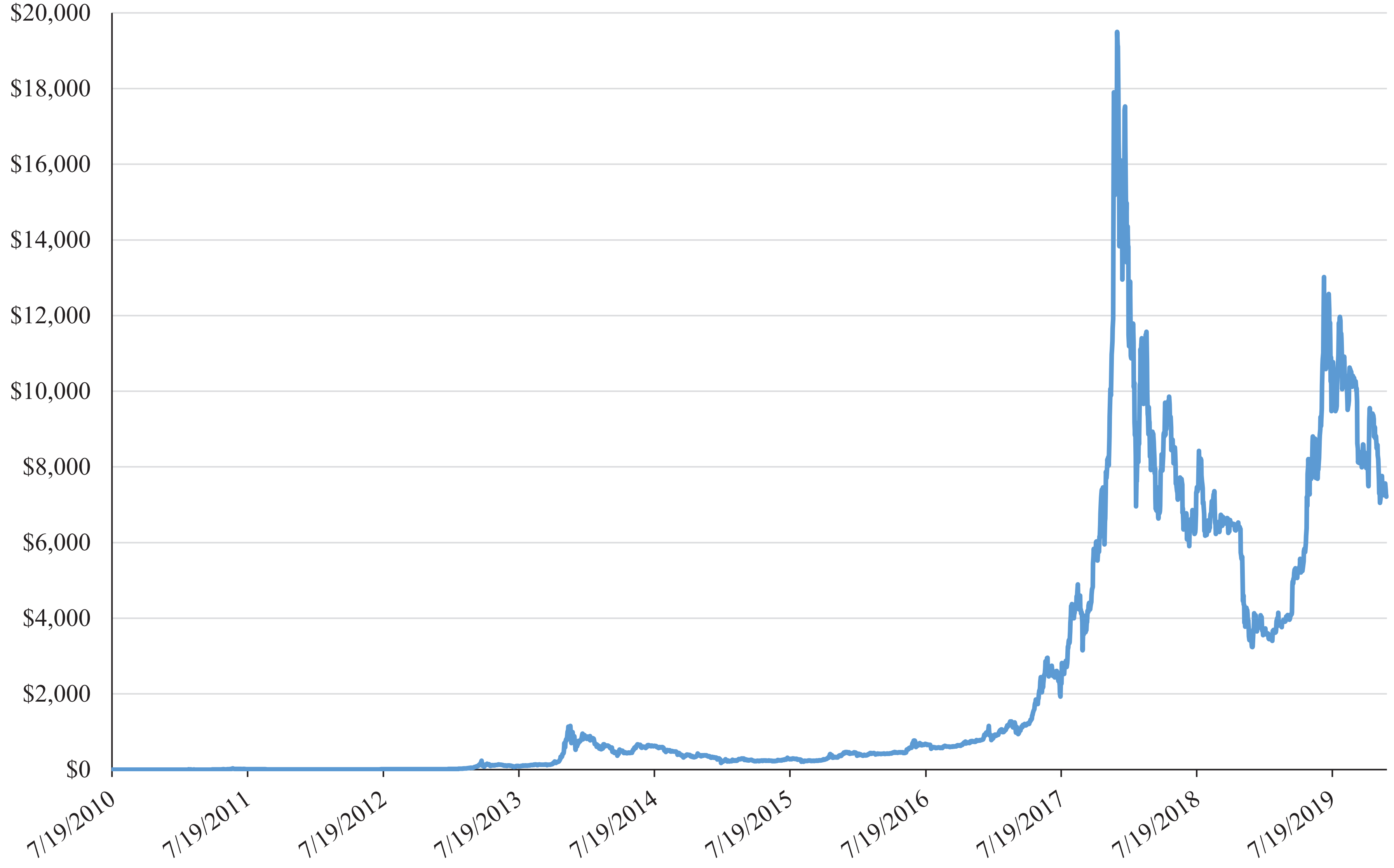
The regression estimates the natural logarithm of the price on the natural logarithm of the prior day's price. The estimation period for each of the cryptocurrencies starts on the date listed above and ends 100 days after.

Standard errors in parentheses; * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Sources:

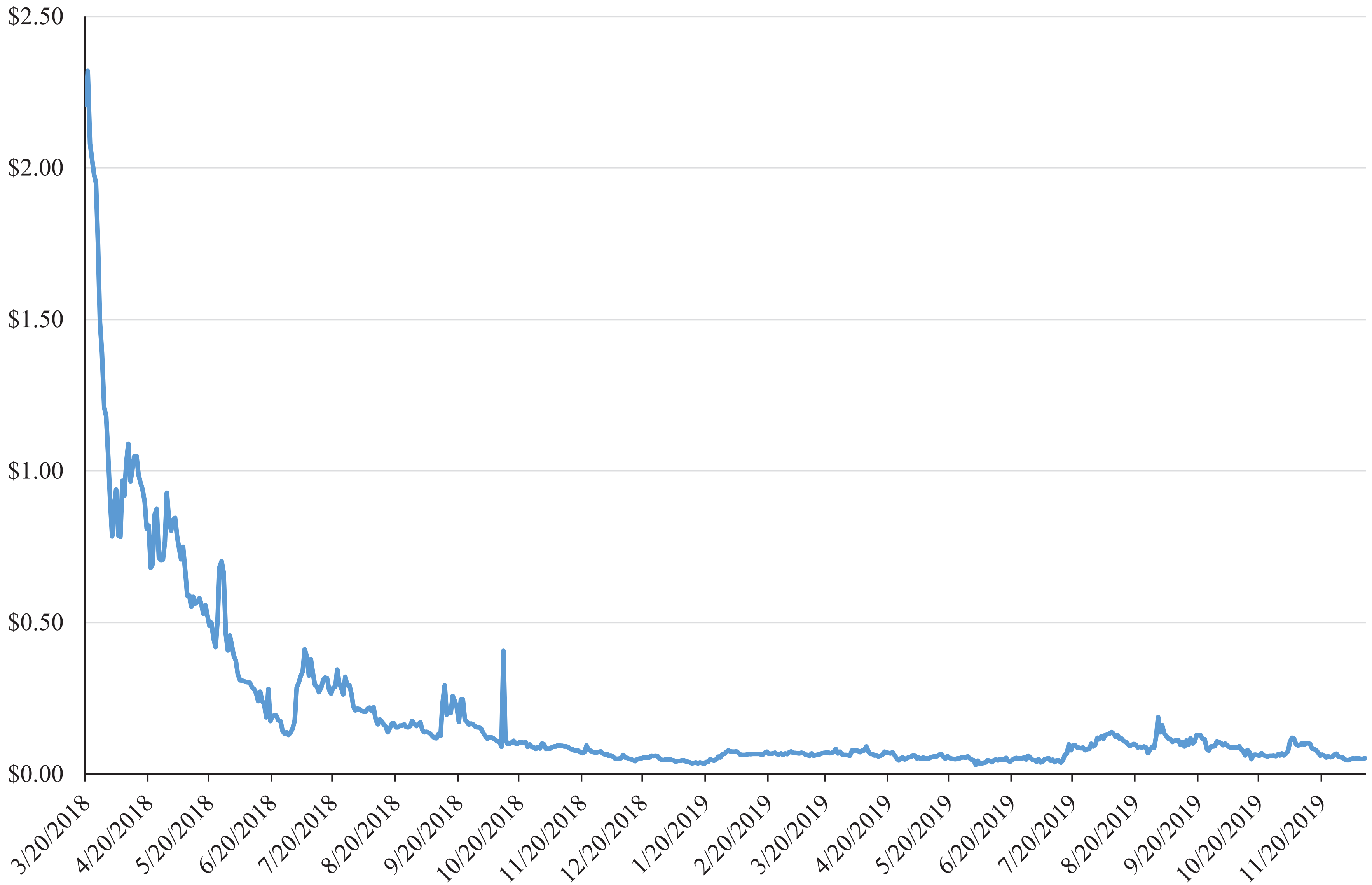
Data is from CoinMarketCap with the exception of Bitcoin data prior to April 28, 2013, which was not available on CoinMarketCap and was obtained from Bloomberg Financial, L.P.

Exhibit 8: Bitcoin's Closing Price


$20,000
$18,000
$16,000
$14,000
$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
7/19/2010
7/19/2011
7/19/2012
7/19/2013
7/19/2014
7/19/2015
7/19/2016
7/19/2017
7/19/2018
7/19/2019

Source: Data prior to April 28, 2013 is from Bloomberg Financial, L.P. Data from April 28, 2013 onward is from CoinMarketCap.

Exhibit 9: Dragon Coin's Closing Price


$2.50
$2.00
$1.50
$1.00
$0.50
$0.00
3/20/2018
4/20/2018
5/20/2018
6/20/2018
7/20/2018
8/20/2018
9/20/2018
10/20/2018
11/20/2018
12/20/2018
1/20/2019
2/20/2019
3/20/2019
4/20/2019
5/20/2019
6/20/2019
7/20/2019
8/20/2019
9/20/2019
10/20/2019
11/20/2019

Source: CoinMarketCap.

Appendix A: Resume

CARMEN A. TAVERAS, Ph.D.

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EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY — **Cambridge, MA**
Ph.D. in Economics — Sep. 2004-Sep. 2010
Dissertation Title: *"Essays on Entrepreneurship."* Used survey data on the portfolios of U.S. families to study the tightness of borrowing constraints for entrepreneurs.

PONTIFICIA UNIVERSIDAD CATÓLICA — **Santiago, Chile**
Postgraduate Diploma in Macroeconomics, Highest Honors — June 2002-July 2004

PONTIFICIA UNIVERSIDAD CATÓLICA MADRE Y MAESTRA — **Sto. Dgo., Dominican Republic**
BA in Economics, *Summa Cum Laude* — Sep. 1998-June 2002

CURRENT POSITION

SECURITIES AND EXCHANGE COMMISSION (S.E.C.) — **Washington, DC**
Financial Economist — July 2014-Present
Review economic research, collect financial data, perform statistical analysis, prepare written reports, and provide summary and expert witness testimony on the economics of potential securities law violations under investigation by the Commission. Experience includes:

- Analysis of trading and calculation of ill-gotten gains from insider trading and other fraudulent trading practices;
- Analysis of trading to detect patterns of market manipulation like spoofing and layering;
- Analysis of preferential trade allocation schemes, or cherry-picking, carried out by investment advisors;
- Analysis of trading and valuation of mutual funds and exchange-traded funds that mislead investors about their performance;
- Use of event studies to measure share price inflation and corporate benefits.

PRIOR POSITIONS

SECURITIES LITIGATION AND CONSULTING GROUP, INC (S.L.C.G.) — **Fairfax, VA**
Principal — Aug. 2010-June 2014

Analyzed securities and prepared expert reports for arbitration and litigation. Coauthored reports in consulting engagements for securities regulators and industry groups. Experience included:

- Annuities, auction rate securities, closed-end funds, collateralized debt obligations, common stock, debt securities, direct participation programs, hedge funds, mutual funds, preferred stock, real estate investment trusts, and tenants-in-common securities.
- Valuation of privately-held businesses as well as mergers and acquisitions due diligence review.

Massachusetts Institute of Technology — **Cambridge, MA**

Teaching Assistant — Sep. 2006-May 2010

Taught graduate and undergraduate courses in Macroeconomics, Introductory Economics, and Research and Communications in Economics.

Research Assistant to Professor Esther Duflo — June 2005-Aug. 2005

International Monetary Fund — **Washington, DC**

Summer Research Assistant — June 2006-Aug. 2006

Ministry of Finance and Economics — **Sto. Dgo., Dominican Republic**

Research Assistant to Chief Economic Advisors — June 2001-June 2002

EXPERT AND SUMMARY WITNESS WORK

- Expert witness in *In the Matter of Christopher M. Gibson*, S.E.C. Administrative Proceeding (July 2019 and September 2016). Report, rebuttal report, direct and cross-examination at trial on a front-running case.
- Summary witness in *U.S. v. David Blaszczak et al.*, U.S. District Court for the Southern District of New York (April 2018). Summary witness exhibits and direct and cross-examination at trial on an insider trading case.
- Expert and summary witness in *S.E.C. v. Sasan Sabrdaran and Farhang Afsarpour*; U.S. District Court Northern District of California San Francisco Division (November 2016). Rebuttal and supplemental reports and direct and cross-examination at trial on an insider trading case.
- Expert witness in *S.E.C. v. James V. Mazzo et al.*; U.S. District Court Central District of California Southern Division (June 2015). Rebuttal expert report and deposition evaluating the statistical analysis performed by the defense expert on an insider trading case.
- Summary witness declaration in *S.E.C. v. Kristine L. Johnson et al.*; U.S. District Court, District of Colorado (February 2015). Summarized information regarding investment in a Ponzi scheme.
- Summary witness declaration in *S.E.C. v. Samuel E. Wyly et al.*; U.S. District Court, Southern District of New York (November 2014). Summarized disclosure/non-disclosure of defendants' offshore option exercises.
- Expert witness in *Gerald and Barbara Galowitz v. Ameriprise Financial Services, Inc.*, FINRA arbitration (May 2013). Direct and cross-examination on behalf of the plaintiffs on asset allocation of annuity investments and damages.

FINANCIAL RESEARCH

- "Large Sample Valuation of Tenancies in Common" with Tim Husson, Craig McCann and Edward O'Neal (2014), *Journal of Real Estate Portfolio Management,* Vol. 20, No. 2, pp. 147-161.
- "Private Placement Real Estate Valuation" with Tim Husson, Craig McCann and Edward O'Neal (2014), *Journal of Business Valuation and Economic Loss Analysis*, Vol. 9, Issue 1, pp. 87-104.
- "What is a TIC Worth?" with Tim Husson, Craig McCann and Edward O'Neal (2012), *PIABA Bar Journal*, Vol. 19. No. 3, pp. 373-392.
- "A Primer on Non-Traded REITs and Other Alternative Real Estate Investments" with Tim Husson and Craig McCann.

- "Rethinking the Comparable Companies Valuation Method" with Paul Godek, Craig McCann, and Dan Simundza.
- "A Monograph on Auction Rate Securities" with Jenny Li and Craig McCann, written for the Securities Division of the North Carolina Secretary of State.
- "An Economic Study of Securities Market Data Pricing by Canadian Trading Venues" with Craig McCann, written for the Investment Industry Association of Canada.

PROFESSIONAL PROGRAMS

Level II Candidate in the Chartered Financial Analyst (CFA) Program and the Financial Risk Manager (FRM) Program.

AWARDS AND FELLOWSHIPS

- Graduate Student Fellowship—Massachusetts Institute of Technology 2004-2010
- Inter-American Development Bank Fellowship—Pontificia Universidad Católica 2002-2004
- Fundapec Fellowship – Pontificia Universidad Católica Madre y Maestra 1998-2002
- National Youth Prize – Ministry of Youth, Dominican Republic 1997

SOFTWARE SKILLS AND FINANCIAL DATA

Stata, Matlab, Bloomberg, Wharton Research Data Services

LANGUAGES

English (fluent), Spanish (native), French (intermediate)

Appendix B: Documents Relied Upon

Case Filings

SEC v. Telegram and TON Issuer, Complaint, October 11, 2019.

Telegram and TON Issuer Filings with the SEC

Form D, Notice of Exempt Offering of Securities, February 13, 2018.

Form D, Notice of Exempt Offering of Securities, March 29, 2018.

Defendants Promotional Material and Other Documents Produced to Investors

TON, Two Page Teaser, sent to investors in January 2018 (TG-005-00015040—41).

TON, Four Page Teaser, sent to investors in November 2017 (TLGRM-006-00000101—104).

Telegram Primer, sent to investors in December 2017 (TLGRM-010-00000513—535).

Telegram Pre-Sale Primer, January 18, 2018 (TG-001-00000054—79).

Telegram Stage A Primer, February 21, 2018 (TLGRM-008-00005149—74).

TON Technical White Paper distributed as Appendix A to the January 18, 2018 Primer (TG-001-00000080—211).

Purchase Agreement for Grams (TG-001-00000014—53).

Purchase Agreement for Grams Stage A of the Subsequent Sale (TG-003-00000223—251).

Telegram Indication of Interest Letter, January 17, 2018 (KPCB-0000623—28).

Telegram Indication of Interest Letter, February 20, 2018 (TLGRM-007-00019093—99).

Telegram Memoranda and Responses to the SEC

Defendants' Responses and Objections to Plaintiff's First Set of Interrogatories, November 22, 2019.

Telegram Memorandum to the Staff of the SEC, June 26, 2018.

Telegram Supplemental Memorandum to the Staff of the SEC, November 20, 2018.

Telegram Second Supplemental Memorandum to the Staff of the SEC, February 27, 2018 [*sic*].

Telegram Third Supplemental Memorandum to the Staff of the SEC, March 18, 2019.

Telegram Fourth Supplemental Memorandum to the Staff of the SEC, July 25, 2019.

Messenger Website

Messenger FAQ: https://telegram.org/faq#q-what-is-telegram-what-do-i-do-here, accessed December 9, 2019.

Textbook, Academic Papers, and Financial Press

Benedetti, Hugo and Leonard Kostovetsky, "*Digital Tulips? Returns to Investors in Initial Coin Offerings,"* Working Paper, May 20, 2018.

Campbell, John, Andrew Lo and A. Craig MacKinlay, "*The Econometrics of Financial Markets,"* Princeton University Press, 1997.

Hankin, Aaron, "*Tether Reverses Claim of 100% Dollar Backing, Sparking Criticism,*" Marketwatch, March 14, 2019.

Kharif, Olga, "*How's that ICO Working Out? Breaking Down the Biggest ICOs from the Past Few Years,*" Bloomberg Businessweek, December 14, 2018.